Satellites approach the Shannon limit

October 28 2008

(PhysOrg.com) -- Satellites are achieving unparalleled efficiency with a new protocol, DVB-S2. The performance of DVB-S2 satellite systems is very close to the theoretical maximum, defined by the Shannon Limit. That efficiency could be pushed even further by network optimisation tools and equipment recently developed by European researchers.

European researchers have created network optimisation hardware and software tools that are able to manage satellite resources more efficiently. The developed tools are able to push the state of the art in satellite transmission technology even further. The increased efficiencies lead to cheap broadband, TV and voice access from anywhere.

The satellite option is a compelling solution to the broadband problem for rural areas, known as the digital divide. Currently, the vast majority of broadband access is confined to Europe's cities and towns, where people live close to telephone exchanges and can access cheap and efficient ADSL.

But vast numbers of Europeans also live in rural or even isolated regions and providing broadband access for them is more complicated.

But not, perhaps, for much longer. Recent progress in satellite technology has led to vastly improved bandwidth efficiencies. The newly developed DVB-S2, which stands for digital video broadcast satellite second generation, improves on DVB-S by a purported 30%.

"Using satellite resource management tools, based on cross-layer

techniques, the IMOSAN project is trying to push that technology even further, in order to make it more attractive not only from the technical aspects, but from the business point of view as well," explains Anastasios Kourtis, coordinator of the EU-funded project.

Cross-layer techniques work across the application, service and physical layers of a communication medium to maximise efficient usage of bandwidth.

Approaching the Shannon Limit

The Shannon Limit establishes the maximum capacity of any channel. A channel is subject to bandwidth and noise restrictions, but its capacity can be improved with clever modulation and multiplexing techniques. The theoretical ultimate limit of a channel for specific bandwidth and signal-to-noise ratio is called the Shannon Limit.

Like the speed of light, that limit cannot be overcome and, again like the speed of light, it is very difficult even to approach it.

The inherent feature of DVB-S2, called Adaptive Coding and Modulation (ACM), allows a satellite system to adapt, in real time, to various transmission conditions and service demands. In this respect, satellite channels are very close to their theoretical limit.

"The IMOSAN consortium developed innovative software and hardware modules and protocols, called the Satellite Resource Management System (SRMS) that apply ACM to voice, data and TV in a clever way, allowing the provision of cost-effective 'triple-play' satellite services to users in rural or isolated areas," Kourtis explains.

Key advance

SRMS was a key advance, but only one of a series of innovations and improvements the team performed on the DVB-S2 system. They also developed hardware and software that supports MPEG-2 HDTV. They developed software that can use both the older Multiprotocol Encapsulation (MPE) scheme and the newer Ultra Light Encapsulation (ULE) one. Both have also been optimised for IPv4 or IPv6.

IPv4 is the current Internet Protocol (IP) that we mainly use for all data communications. But the unique IP addresses are running out rapidly, and the protocol is creaking under the strain of modern network demands. IPv6 will address this shortage and offer other new features to improve the internet.

It offers so many unique addresses that it would be possible to give an address to every individual grain of sand on earth and still have enough numbers left to give a unique one to every individual on the planet, any pets they have and all the devices they own. IPv6 also provides better security and error correction and it is the IP standard of the future. Including it in their system means that IMOSAN has future-proofed its work.

The work of IMOSAN is expected to have significant impact on satellite communications.

“The innovative tools and techniques that were developed in the frame of IMOSAN, gave [us] a great opportunity [for] efficient collaboration among private-sector companies and public academic organisations, with a common goal: to provide cost-effective broadband satellite services to rural and isolated areas,” Kourtis concludes. This should help tackle the digital divide problem.

This is part one of a two-part feature on the IMOSAN project funded by the ICT strand of the EU’s Sixth Framework Programme for research.

Part two will appear on 4 November.

Provided by ICT Results